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MINERAL RESOURCE INVENTORY OF THE PARADOX SALT BASIN UTAH AND COLORADO

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mine located southwest of Moab, Utah, which was opened in 1964. This mine started out as a conventional underground operation but was converted to solution mining at a later date. Additional potash exploration has been done by other companies, but as of now, no new operations are planned for the immediate future.

There are 29 evaporite cycles that occur in the Paradox Basin. Of these, 18 cycles contain potash, but only 11 cycles are potentially valuable (Hite, 1961). Several of the salt beds are exceptionally large. One is known to be 110 miles long, about 30 miles wide, with a thickness in one locale of more than 400 feet. A well which penetrated the salt center of the Salt Valley anticline cored about 300 feet of potash salt. However, most potash-bearing zones are not thick, and many of the thicker sections probably are due to flowage and concentration of salt into the crests of folds. Original thickness of potash salt beds is not known, but thickness of undeformed potash salt beds probably range from a feather edge to 100 feet, averaging about 20 feet. The Paradox salt basin has been folded and faulted in its central position by the formation of several belts of salt anticlines, some of which are the piercement or diapiric type and others of which are the simple or non-piercement type. The piercement anticlines are shown on most of the plates (plates 2 to 6), but were omitted from plate 7 to avoid cluttering.

The depth of the potash zones ranges from a few hundred feet in the piercement salt structures to several thousand feet in the deeper parts of the basin. The principal potash minerals are sylvite (KCl) and carnallite ($K \cdot MgCl_3 \cdot 6H_2O$). The presence of carnallite makes the area a potential source of magnesium as well. The market for potash is presently dominated by Canadian production, but with the expected increase in demand for potash there will be a need to develop the potash resources in the Paradox Basin. Improved technology in solution mining will also help in development of these resources. Plate 7 shows the areas which have been or are presently leased for potash. These leases are located in favorable potash areas that are not too deformed and are at a reasonable depth. The presence or absence of bedded potash, in test wells for oil and gas, usually is known from published sample and core descriptions, or from logs of wells available through commercial electric log libraries. The results of core holes and test wells drilled for potash are not as well publicized; in fact, much of the information is held completely confidential. As a consequence, although the broad outlines of the potash basin are known, detailed figures on thickness of beds, K_2O content and reserves of commercial ore generally are not available. *U. S. Bureau of Mines* Bulletin 630 (1965), estimates potash reserves in the Paradox Basin to be 254 million tons in the known category and 161 million tons in the inferred category.

COPPER POTENTIAL

The occurrences and locations of copper mineralization are shown on table 3.

Salt Valley Anticline

There are several small abandoned copper and copper-silver mines in the area of the Salt Valley anticline. These deposits were worked intermittently from the early 1900s through the 1930s. The pay horizon is in the Morrison Formation in both the Salt Wash and Brushy Basin Members. An important mine, the Hoosier, is located on a fault fissure on the southwest flank of the Salt Valley anticline in section 5, T. 23 S., R. 21 E., Grand County, Utah. It is reported to have produced 100,000 ounces of silver in 8 percent copper ore, which was shipped to the smelters by truck. The

silver values were high enough to pay for mining and shipping. The mine has reportedly produced $200,000 in copper (Gail Tibbets, oral communication, 1979 and Fischer, 1936).

In the early 1970s a copper leach operation was begun based on the disseminated copper ore of the Morrison Formation found on the southwest flank of the Salt Valley anticline. About 21,000 tons of ore were mined before the operation was shut down because of inefficiencies. Eight to 10 million tons of low-grade copper ore were reportedly blocked out for this operation (Gail Tibbets, oral communication, 1979).

Dane (1935) reports another copper area west of the Sevenmile fault in which the Moab Tongue of the Entrada Formation is mineralized. There are several abandoned copper mines and an old copper mill in Mill Canyon along the Sevenmile fault zone. Large tonnages of low grade copper have been drilled out in this area which make up a valuable potential resource for the future.

Lisbon Valley Area

The Big Indian copper mine is located in the N½ section 34, T. 29 S., R. 24 E., in San Juan County, Utah, in the Big Indian mining district. The mine is located on the Lisbon Valley fault and has been mined sporadically since 1913. The first copper mill was constructed in 1917 (Butler, 1920, p. 612). The mine was again activated during World War II and again in the late 1960s and early 1970s. Azurite and malachite ores were mined from the Dakota-Burro Canyon formations which form the hanging wall along the Lisbon Valley fault. A heap leach operation was used to recover copper in a new mill constructed in the late 1960s. This operation closed in the early 1970s and has not reopened since.

Copper has been mined from several open pits in sections 17, 26, and 36, T. 30 S., R. 25 E. in the southern part of the Lisbon Valley area. The Centennial Pit is the largest and is located in NW¼ of section 26, T. 30 S., R. 25 E. and contains oxide ores at the surface and sulfide ores at depth. The main sulfide ore contains chalcocite (Cu_2S), which occurs erratically in coal beds of the Dakota Formation. The ore produced and ore reserves left are thought to be in the 10 to 20 million ton range. There is no work being done in the area at the present time. Both copper and uranium mineralization are found along the Lisbon Valley fault, but apparently the copper was emplaced in a different time and perhaps along a different path (Schmitt, 1968).

Other Areas

The Cashin and Cliff Dweller copper-silver mines are located in section 13, T. 47 N., R. 19 W., Montrose County, Colorado, along a mineralized fault zone in the Entrada Sandstone (LaPlata Sandstone of Emmons, 1905). These deposits are in fissure veins associated with high angle faults of small vertical displacement. The ore minerals are native copper, chalcocite, and a little covellite. Production from 1899 through 1905 was 280,000 ounces of silver and 500,000 pounds of copper, not including native copper (Emmons, 1905). The Sunrise and the Copper Rivet mines are located in this vicinity but have had very little economic impact.

Two mine areas in the Abajo Mountains have produced a small quantity of copper ore. Both have been inactive for a long time. The Copper Queen mine is located in SE¼ section 35, T. 33 S., R. 22 E. (unsurveyed) and consists of small drifts in the Dakota and Burro Canyon Formations. The mineralizations are coatings on bedding and crossbedding